On the Orientation Dependence of Pitting in Single Crystal Beryllium

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In a previous study, the pitting potential of single crystal beryllium (Be) in 0.01 M sodium chloride was shown to decrease with crystallographic orientation in the order $(0001) > (10\bar{1}0) > (11\bar{2}0)$.[1] Damage due to metastable pitting (below E_{pit}) was directly proportion to pitting potential; the (0001) surface having the greatest amount of damage prior to stable pitting while no metastable pitting damage was observed on the $(11\bar{2}0)$ surface prior to stable pitting. In addition, the primary passivation current density for the (0001) surface in a simulated critical pitting solution was lower than that for the $(10\bar{1}0)$ and $(11\bar{2}0)$ surfaces in the same solution. Given the crystallographic nature of the pits and apparent orientation dependent propagation (Figures 1a and 1b) it was proposed that pit propagation in Be was not controlled by salt film formation, rather, that a bulk metal property that varies with crystallographic orientation, such as covalent bonding between atoms in the lattice, controls charge transfer and pit stability.

In this investigation we have used video photography of the sample surface during potentiostatic holds below the pitting potential to examine the roles of critical aspect ratios, dissolution current densities, and propagation directions in metastable pit development. In addition to these results, electron density distributions in Be and the impact on bonding will be addressed with respect to etch pit geometries.

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1. R.S. Lillard, *J. Electrochem. Soc.*, **148**, B1-B11, (2001).

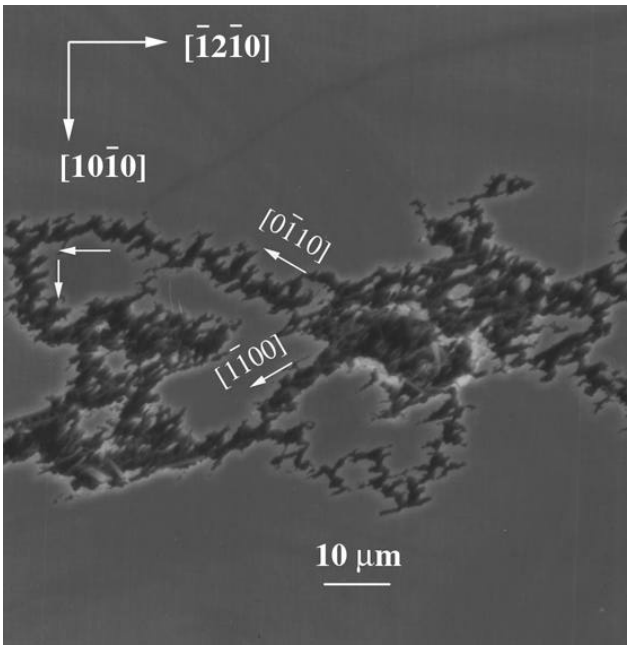

Figure 1a - *SEM micrograph of typical corrosion pits in the (0001) surface of Be after potentiodynamic polarization above the pitting potential in 0.01 M NaCl. Propagation was often in the* $\langle 10\bar{1}0 \rangle$ *and* $\langle \bar{1}2\bar{1}0 \rangle$ *families of directions as noted by the arrows.*

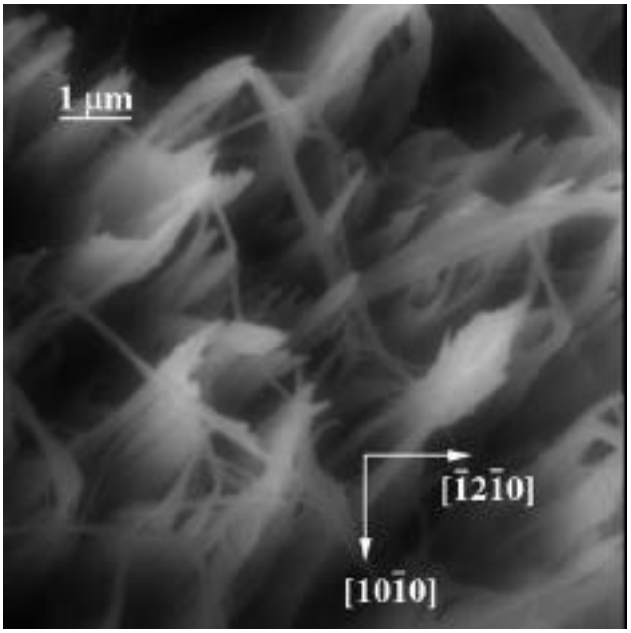

Figure 1b - *SEM micrograph of pit interior from Figure 1a showing Be fibers normal to the surface "left behind" by the dissolution reaction. (Note: A small degree of tilt was introduced to allow a clear view of the pit interior.)*